



Ethnobotanical study of medicinally important plants used in Paschim Medinipur district, West Bengal, India

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Abstract

An ethnobotanical study was carried out to gather information on the use of medicinal plants to treat various health problems by local inhabitants of a few rural and urban areas of Paschim Medinipur district of West Bengal, India. The dose, mode of use and method of preparation of remedy were recorded along with local name, family, part of the plant used and short profile of informant on the basis of semi structured questionnaire. During the survey, a total of 45 informants were selected from various rural and urban areas, who were selected on the basis of their knowledge of ethnomedicine. A total of 55 medicinal plant species belonging to 32 families are used by the local people of the district in the form of infusion, oil, decoction, paste, latex, etc., either as a monoherbal or polyherbal drug to treat various ailments such as diabetes, dysentery, gastric problem, snake bite, skin rash, rheumatoid arthritis among others. The most commonly used plant part is leaf followed by fruit, root, seed, bark, stem, rhizome, latex, flower and whole plant. Ethnobotanical data was analyzed using three appropriate quantitative tools like Use Value (UV), Informants Consensus factor (ICF) and Fidelity Level (FL). In this study, herb is the most used life form employed in herbal medicine formulation and it is followed by trees, shrubs, lianas and non-woody climbers. Most of the plant species used for crude medicines are wild while the rest are cultivated for food, vegetables, spices and flowers. This study can facilitate the conservation of ethnobotanical knowledge and diversity of medicinal plants, which are gradually disappearing.

Keywords: Ethnobotanical survey, Ethnomedicine, Herbal resources, Quantitative analysis

1. Introduction

Medicinal plants with their varied pharmacological activities play a beneficial role in the treatment of various health problems (Regassa *et al.*, 2017). Medicinal plants have been documented in the Indian System of Ayurveda dates back to the first millennium BC and the discovery of modern drugs from plant parts started at the very early of 19th century when Friedrich Sartherner isolated morphine, a sleep-inducing agent from opium. His work not only demonstrated the potential of plant derived compounds but also paved the way for the development of more systematic

approach to drug discovery and pharmacology (Atanasov *et al.*, 2015). It is reported that in India about 2500 plant species of more than 1000 genera are used in indigenous medicine (Sarkhel, 2014; Sarkhel, 2015). On the basis of research publications, 65-80% of the population in developed countries rely on medicinal plants for their primary healthcare problems (Agra *et al.*, 2007).

The people of paschim Medinipur district in West Bengal possess valuable knowledge of plant-based medicines. These ethnic communities are increasingly

exposed to modernization (Sarkhel, 2014). People in rural and urban areas still favor the use of herbal or plant derived medicines to treat various ailments, despite the availability of orthodox medicines (Buwa-Komoreng *et al.*, 2019). In fact, ethnomedicine is their first priority to treat ailments because it is locally available, has less side effects and is less expensive than modern drugs (Reimers *et al.*, 2019). These medical systems are practiced by healers or elders of the community, passing down from generation to generation orally (Kebebew and Mohammed, 2017). Most of the information possessed by the healers and village elders is being eroded due to lack of interest of the younger generation and the absence of proper documentation, which has become a significant factor in phytobiodiversity loss (Kebebew and Mohammed, 2017). Many indigenous plants are disappearing due to climate change, socio-economic change and its over exploitation (Otieno *et al.*, 2007). Thus, there is an urgent need to document indigenous knowledge about herbal preparation, treatment of different disease, identification of medicinal plant and their mode of collection and conservation of plants. This article has focused on documentation of indigenous plants used in the treatment of different kind of health problems in paschim Medinipur district of West Bengal, India.

2. Materials and methods

2.1. Survey area

Paschim Medinipur district is one of 23 districts of West Bengal, India with enormous vegetational variations (Fig. 1). West Midnapore district covers a geographical area of 9.75 thousand square kilometers, which represents 11.01 percent of the total area of the state, which measures 88.75 thousand square kilometers. Broadly, the district can be divided into two natural zones. Geographically the study area is located within 22.4080°n and 87.3811°e. NH 14 and NH 16 run from Bankura to Balasore, serving as the approximate boundary between these two divisions. To the east of this road lies a flat area of fertile alluvial soil while to the west, the Chota Nagpur Plateau descends gradually,

forming undulating area of infertile laterite rocks and soil. The importance of the district also extends to its forest area with 1.70 thousand square kilometers which is 14.31 percent of the total forest area of the state (11.88 thousand square kilometers). These statistics highlight the significant contribution of west Midnapore to both the land and forest resources of the state (Bhunia, 2020).

The average annual precipitation of this district is 2,111mm and the region is consisting of dense dry deciduous forests in west to marshy wetlands in east of this district. Predominantly hot and humid climate prevails in this district with short winter. Thus, there are different floristic compositions due to different geographical and climatic conditions (Ghosh, 2008; Samanta and Sauris, 2012).

As per the 2011 census of West Midnapore, West Bengal, the total population was recorded as 5,913,457. Out of this population, 880,015 persons belong to Scheduled Tribes (ST), which constitutes about 14.88% of the total population. Additionally, the Scheduled Caste (SC) population is reported to be 1,128,269, which is about 19.08% of the total population. This data highlights the significant representation of both ST and SC communities in the population (Anonymous, 2011).

2.2. Interview with the informants

During the survey, total of 45 informants were chosen from different rural and urban areas on the basis of their knowledge about ethnobotanical drugs. The study is conducted in eight village area and one urban area of paschim Medinipur district.

As the researchers understood the local languages, Santhali and Bengali, the interviews were conducted as open discussions, so that the informants could freely share their knowledge (Modak *et al.*, 2015). Verbal consent was also taken from them explaining the need of co-operation and the importance of proper documentation of their ethnobotanical knowledge (Kumar *et al.*, 2013). The survey was conducted from August, 2017 to July, 2019. Each survey sites were visited once or twice depending on availability of herb plants, especially during monsoon and autumn.

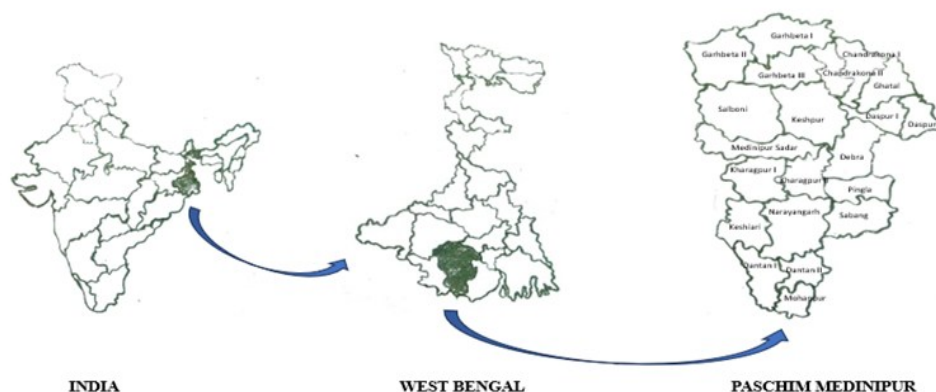


Fig. 1. Map of the study area

2.3. Data collection and identification of the plant species

Before collecting any information, the consent from the informants obtained in the form of Prior Informed Consent (PIC) format (Fig. 2). A sheet was also prepared with a series of questions to collect data systematically along with short profile of informants (Modak *et al.*, 2015). Local name of plant, growth form, availability in natural resources, collection method, storage, conservation needs, name and symptoms of health problems treated by plant parts, method of crude drug preparation, mode of use were included in the questionnaire (Kumar *et al.*, 2013). Plants are primarily identified by their local names, either through photograph or directly visiting their garden or woodland areas. Several plant species were collected mostly in their flowering stage to make herbarium for their identification but rare and protected species were avoided during the field study. These protected species were photographed only whenever it possible (Modak *et al.*, 2015).

Fig. 2. Prior Informed Consent (PIC) format and short profile of informer with questionnaires

After the collection of fresh plant material or specimen need to dry between folds of paper for 24 to 48 hours. Then the plant materials are pressed with corrugated cardboard sheets of 3 to 4 inch until the specimen is completely dry. Place the specimen on an herbarium sheet using glue. Spray the specimen with a preservative like fungicide. Label the specimen in the lower right-hand corner of the sheet with the name and date of collection, habit, and locality of the specimen. A nylon rope is used tie cardboard perfectly for most plant specimen (Mondal, 2005).

Plant identification was carried out partly with the help of Bengal Plants (Vol. I and Vol. II) by David Prain (1903) and Medicinal Plant Resources of South West Bengal (Vol. I and Vol. II) published by research circle, directorate of forests, Government of West Bengal (2010). Scientific name and author citation of plant species also checked by Tropicos: <https://tropicos.org/home> and India Biodiversity Portal: <https://indiabiodiversity.org/species/show/262797> databases and some plant specimens have been identified from Central National Herbarium (CAL), Howrah.

Out of total number of informants, females are 22 and male are 23 in number. The informants are divided into 6 age groups (Table 1) as per the social classes, marital status, education status and the occupation of informants (Ayankogbe *et al.*, 2009). Seven informants selected for their expertise in traditional healing practices, environmental knowledge, residence, professional activity and age while nine elders selected for their knowledge, were chosen to gather information on nearly forgotten plant uses. Twenty nine informants were selected for ethno-pharmacological survey who have knowledge about medicinal plants (Tongco, 2007).

Table 1. Socio-demographic data of respondents

Sl. No.	Demographic factors		No. of respondents
1	Sex	Female (F)	22
		Male (M)	23
2	Age group	21-30	5 (F)
		31-40	3 (F), 5 (M)
		41-50	3 (F), 3 (M)
		51-60	8 (F), 7 (M)
		61-70	3 (F), 5 (M)
		71-80	3 (M)
3	Category	ST	27
		SC	08
		General	10
4	Marital status	Single	4 (F), 2 (M)
		Married	14 (F), 20 (M)
		Widow/Widower	4 (F), 1 (M)
5	Education	Illiterate	1 (F), 2 (M)
		Incomplete higher education	8 (F), 3 (M)
		Complete higher education	13 (F), 18 (M)
6	Occupation	Government employee	2 (M)
		Retired employee	3 (M)
		Health care worker	1 (F)
		Part time teacher	1 (F)
		Farmerette/Farmer	3 (F), 9 (M)
		House wife	14 (F)
		Self employed	1 (F), 9 (M)
		Unemployed	2 (F)

2.4. Data analysis

Ethnobotanical data were summarized and analyzed using appropriate quantitative tools as follows:

2.4.1. Use value (UV): It was calculated using the following equation.

$$UV = \sum U_i / n$$

In this equation 'U_i' is the number of use reports for each medicinal plant species by each informant and 'n' is the total number of informants interviewed during the field survey.

Use values determine value of each plant species in the traditional medicine by informants (Dey and De, 2012). The plant species are cited by informants more frequently show a higher use value and plant species with lesser citation show a lower use value (Apiah *et al.*, 2018).

2.4.2. Informants consensus factor (ICF): Calculation of ICF is used to know the use of popular plant species against a particular disease or health complications. It was calculated using the formula (Mahato *et al.*, 2019):

$$ICF = N_{ur} - N_t / N_{ur} - 1$$

N_{ur} is the number of use citation in each ailment category and N_t is the number of plant taxa used for a particular ailment category. This formula is used to determine the homogeneity of data reported by informants. A higher Fic value indicates less plant use by informants for treating a particular health problems and low Fic value specify the informant's disagreement on using a particular plant species to treat particular health problems (Modak *et al.*, 2015).

2.4.3. Fidelity level (FL%): FL is used to discover the most reported taxa to treat a specific ailment by the informants using the formulas (Tugume *et al.*, 2016).

$$FL \% = I_p / I_u \times 100$$

I_p is the number of informants who stated the usage of a taxa to treat a specific ailment and I_u is the total number of informants who reported the taxa for any use (Tugume *et al.*, 2016). High FL value of any given taxa implies its extensive acceptance among the informants in the treatment of a particular ailment and low FL value of a given plant species represents its use for other ailment categories (Modak *et al.*, 2015).

3. Results and discussion

3.1. Plant diversity and plant parts used

A total of 55 plants belonging to 49 genera and 32 families were used by the informants to treat against various health problems. The plants are tabulated with their scientific name, local name, family, parts used and used to cure ailments (Table 2). Due to diversity of plant species, the Apocynaceae family provided with largest number of species, 8 species, followed by

Acanthaceae (4 species). Three species have been found in the Euphorbiaceae, Combretaceae and Meliaceae families. Malvaceae, Myrtaceae, Asteraceae, Phyllanthaceae, Apiaceae, Poaceae and Zingiberaceae were represented by two species each. Other families were represented by one plant species each. This result showed that the study area is rich in medicinal plant diversity (Fig. 3).

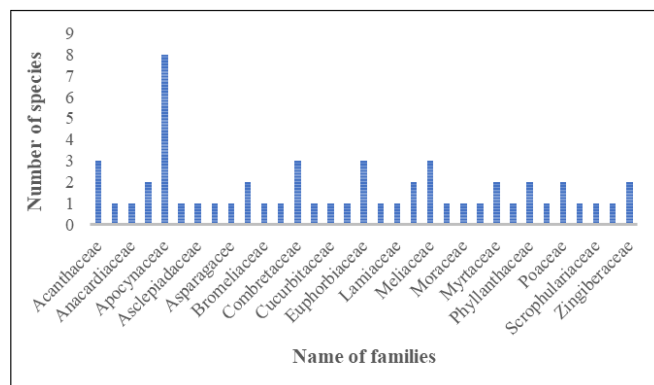


Fig. 3. Number of species recorded in each family

3.2. Growth forms of medicinal plants

This study found that herbs (38%) are the most commonly used plant life forms for medicinal purposes (Tugume *et al.*, 2016), followed by trees (34%), shrubs (22%), woody climbers (4%) and climber (2%) respectively (Jima *et al.*, 2018). Herbal medicines are preferred due to their availability throughout the year as they are relatively drought resistant and unaffected by seasonal changes (Tugume *et al.*, 2016) (Fig. 4).

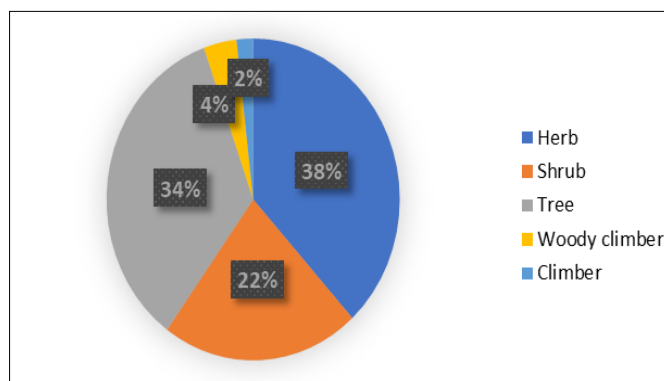


Fig. 4. Percentage composition of habit forms of the ethnomedicinal species

3.3. Use of plant parts

Leaves are the most commonly used plant part in herbal medicine while flowers, twigs and the whole plant are the least utilized. The healing properties of herbal medicines depend on the presence of specific biologically active compounds in certain parts of the plant (Fig. 5).

Table 2. List of recorded plant species with their ethnomedicinal use and Use Value (n=55).

Sl. No.	Scientific name	Local name	Family	Part(s) used	Ailments	UR	UV
1	<i>Abutilon indicum</i> (L.) Sweet	Tipi	Malvaceae	Fruit, leaf	Skin infection	05	0.11
2	<i>Achyranthes aspera</i> L.	Apang	Amaranthaceae	Root	Dysentery	10	0.22
3	<i>Aegle marmelos</i> (L.) Correa	Bel	Rutaceae	Fruit	Acidity and gastric problem	12	0.26
4	<i>Aloe barbadensis</i> Mill.	Gritakumari	Asphodelaceae	Leaf	Antiaging, acne, used for skin care, constipation, insect bite and hair care	31	0.68
5	<i>Alstonia scholaris</i> (L.) R. Br.	Chhatim	Apocynaceae	Milky latex	Mouth ulcer	05	0.11
6	<i>Ananas comosus</i> L.	Anaras	Bromeliaceae	Fruit	Gastric problem and scurvy	11	0.24
7	<i>Andrographis paniculata</i> (Burm.f.) Wall. Ex Nees	Kalmegh	Acanthaceae	Whole plant	Diabetes, tape worm infestation and blood purifier	35	0.77
8	<i>Aristolochia indica</i> L.	Ishwarmooli	Aristolochiaceae	Root	Snake bite	12	0.26
9	<i>Asparagus racemosus</i> Willd.	Shatamuli	Asparagaceae	Root	Diabetes, liver problem, leucorrhoea and gastric problem	16	0.35
10	<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae	Leaf	Diabetes, skin rash, blood purifier, acne, chicken pox and small pox	40	0.88
11	<i>Bacopa monnieri</i> (L.) Pennell	Brahmi	Scrophulariaceae	Leaf, stem	Memory enhancer	16	0.35
12	<i>Barleria lupulina</i> Lindl.	Kanta bishalyakarani	Acanthaceae	Leaf	Cuts and wounds	07	0.15
13	<i>Calotropis gigantea</i> (L.) W. T. Aiton	Akanda	Apocynaceae	Leaf	Arthritis	07	0.15
14	<i>Carica papaya</i> L.	Penpe	Caricaceae	Leaf, fruit	Dengue and digestive problems	28	0.62
15	<i>Catharanthus roseus</i> (L.) G. Don	Nayan tara	Apocynaceae	Leaf	Diabetes	09	0.2
16	<i>Centella asiatica</i> (L.) Urban	Thankuni	Apiaceae	Leaf	Diarrhoea and constipation	25	0.55
17	<i>Cissus quadrangularis</i> L.	Har jora	Vitaceae	Stem	Bone fracture	05	0.11
18	<i>Coccinia grandis</i> (L.) Voigt.	Kundri	Cucurbitaceae	Fruit	Diabetes	05	0.11
19	<i>Coriandrum sativum</i> L.	Dhane	Apiaceae	Seed	Digestive stimulant	12	0.26
20	<i>Curcuma longa</i> L.	Halud	Zingiberaceae	Rhizome	Blood purifier, wound and skin rash	32	0.71
21	<i>Cymbopogon citratus</i> (DC.) Stapf	Dhanantary	Poaceae	Leaf	Cold and cough	16	0.35
22	<i>Cynodon dactylon</i> (L.) Pers.	Durba ghas			Sinusitis	03	0.06
23	<i>Euphorbia neriifolia</i> L.	Manasa	Euphorbiaceae	Leaf	Cold and cough	06	0.13
24	<i>Ficus racemosa</i> L.	Joggo dumur	Moraceae	Fruit	Dysentery and diarrhoea	10	0.22
25	<i>Glycyrrhiza glabra</i> L.	Yasthimadhu	Fabaceae	Root	Gastric problem, sore throat and cough	08	0.17
26	<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult	Gurmar	Apocynaceae	Leaf	Diabetes	09	0.2

27	<i>Hemidesmus indicus</i> (L.) R. Br.	<i>Anantamool</i>		Root	Gastric problem	06	0.13
28	<i>Hibiscus rosa-sinensis</i> L.	<i>Joba</i>	Malvaceae	Flower, leaves	Irregular menstruation and boil	15	0.33
29	<i>Holarrhena antidysenterica</i> (L.) Wall. ex A. Don.	<i>Kurchi</i>	Apocynaceae	Bark	Dysentery	07	0.15
30	<i>Hygrophila auriculata</i> (K. Schum.) Heine	<i>Kulekhara</i>	Acanthaceae	Leaf	Increase blood cell count	23	0.51
31	<i>Ipomoea aquatica</i> Forssk.	<i>Kolmi</i>	Convolvulaceae	Twig	Insect bite	05	0.11
32	<i>Jatropha curcas</i> L.	<i>Sada bherenda</i>	Euphorbiaceae	Latex	Dysentery	09	0.2
33	<i>Jatropha gossypifolia</i> L.	<i>Lal bherenda</i>			Swollen gums and pain and dysentery	10	0.22
34	<i>Justicia adhatoda</i> L.	<i>Bakos</i>	Acanthaceae	Leaf	Fever, bronchitis, cold and cough	35	0.77
35	<i>Mangifera indica</i> L.	<i>Aam</i>	Anacardiaceae	Seed	Diabetes	09	0.2
36	<i>Moringa oleifera</i> Lam.	<i>Sajne</i>	Moringaceae	Leaf	Blood pressure, small pox, obesity and cough	17	0.37
37	<i>Nerium oleander</i> L.	<i>Shwet karabi</i>	Apocynaceae	Milky sap, root	Conjunctivitis and snake bite	13	0.28
38	<i>Nyctanthes arbor-tristis</i> L.	<i>Shiuli</i>	Oleaceae	Leaf	Fever	28	0.62
39	<i>Ocimum tenuiflorum</i> L.	<i>Krishna tulsi</i>	Lamiaceae	Leaf	Cough, fever and bronchitis	28	0.62
40	<i>Phyllanthus emblica</i> L.	<i>Amloki</i>	Phyllanthaceae	Fruit	Gastric problem and hair care	19	0.42
41	<i>Phyllanthus niruri</i> L.	<i>Bhumi amla</i>		Leaf	Jaundice and liver problem	09	0.2
42	<i>Psidium guajava</i> L.	<i>Peyara</i>	Myrtaceae	Leaf, bark	Toothache, diarrhoea and dysentery	15	0.33
43	<i>Rauvolfia serpentina</i> (L.) Benth. Ex Kurz	<i>Sarpagndha</i>	Apocynaceae	Root	Snake bite	15	0.33
44	<i>Rauvolfia tetraphylla</i> L.	<i>Bara Chandrika</i>				15	0.33
45	<i>Shorea robusta</i> Gaertn. F.	<i>Sal</i>	Dipterocarpaceae	Fruit	Dysentery and diarrhoea	13	0.28
46	<i>Swietenia mahagoni</i> (L.) Jacq.	<i>Mahgoni</i>	Meliaceae	Seed	Diabetes	15	0.33
47	<i>Swietenia macrophylla</i> King	<i>Mahgoni</i>				15	0.33
48	<i>Syzygium cumini</i> (L.) Skeels	<i>Jamun</i>				14	0.31
49	<i>Tagetes erecta</i> L.	<i>Ganda</i>	Asteraceae	Leaf	Cut and wounds	14	0.31
50	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	<i>Arjun</i>	Combretaceae	Bark	Acidity	13	0.28
51	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	<i>Bahera</i>		Fruit	Gastric problem	08	0.17
52	<i>Terminalia chebula</i> Retz.	<i>Haritaki</i>				08	0.17
53	<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms.	<i>Gulancha</i>	Menispermaceae	Stem	Diabetes and rheumatoid arthritis	09	0.2
54	<i>Tridax procumbens</i> L.	<i>Tridhara</i>	Asteraceae	Leaf	Cut and wounds	10	0.22
55	<i>Zingiber officinale</i> Roscoe	<i>Ada</i>	Zingiberaceae	Rhizome	Cough and digestive problems	35	0.77

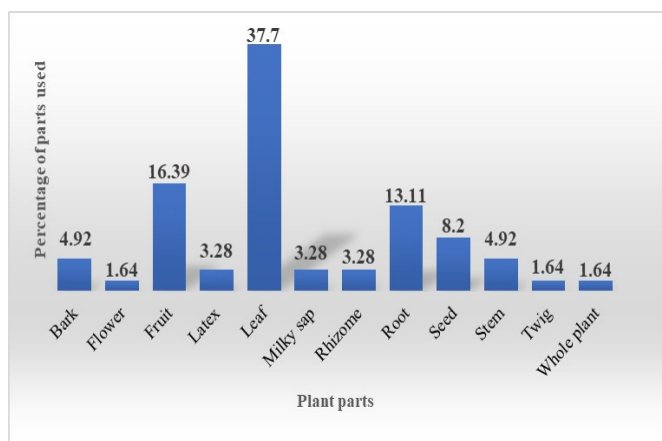


Fig. 5. Percentage of plant parts of used

3.4. Methods of preparation and mode of use in ethnomedicine

Information from most of the informants indicates that medicinal plants are mainly processed in fresh/raw form and the mode of administration is oral. Additives used for the preparation of medicines helps to reduce discomfort and improve taste and are believed to enhance the bioactive molecules of the remedy. Out of the 50 species in mono herbal formulations, a specific percentage were combined with various additives. These includes salt, sheep's milk, palm sugar, termite mound soil, water, mustard oil, ajwain seeds, honey, sugar cake or batasa, curd and ginger (Table 3).

During the documentations of information on drug preparation, informants stated different skills associated with herbal preparations. The method of preparation varies based on the type of disease being treated. For example, leaf paste of *Azadirachta indica* A. Juss., is applied to the rash area of the skin. Herbal remedies were prepared through various methods, including burning, boiling, crushing, cooking, decoction, drying and powdering (Fig. 6).

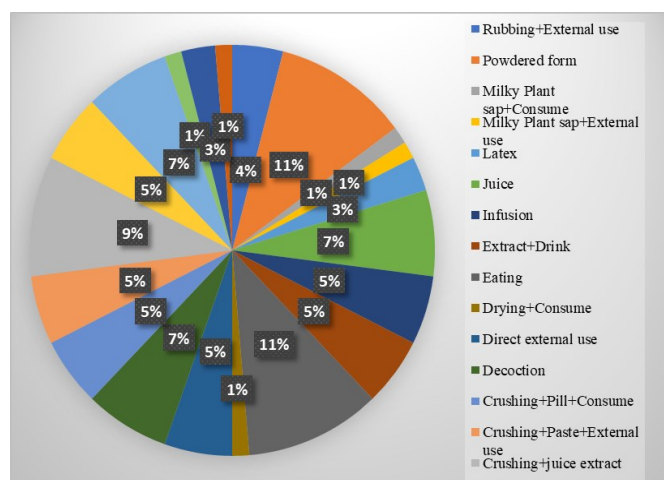


Fig. 6. Percentage composition of different forms of crude drug administered

3.5. Quantitative ethnobotanical data analysis

3.5.1. Availability of the plant resources: Most of the plant species used to make crude medicines are wild and planted in nature for its conservation and the rest are cultivated for food, vegetables, spices and flower. There is an urgent need to develop appropriate conservation strategies to ensure the availability of these valuable resources for future sustainable use. Sustainability of phytodiversity requires the exploration of traditional knowledge of each plant and creating awareness among the general public about the conservation of threatened species which can be achieved by educating them about the importance of conservation. Healers are aware of importance of conservation of medicinal plants and are growing some of the rarely available and culturally important medicinal plants in their backyard/courtyards in a conservation way for immediate use. They tried to visit forest or hilly area for searching medicinally important plant species and collect it in sampling stage. After finding some rare plants, they tried to preserve them by planting them in their garden.

3.5.2. Use value of plant species: High use value indicates the high level of use of medicinal plants as reported by the informants (Apiah *et al.*, 2018). In this study, plants that scored high UV were *Azadirachta indica* A. Juss. (0.88), *Andrographis paniculata* (Burm.f.) Wall. ex Nees (0.77), *Justicia adhatoda* L. (0.77), *Zingiber officinale* Roscoe (0.77), *Curcuma longa* L. (0.71), *Aloe barbadensis* Mill. (0.68), *Carica papaya* L. (0.62), *Nyctanthes arbor-tristis* L. (0.62), *Ocimum tenuiflorum* L. (0.62). Other species such as *Centella asiatica* (L.), Urban (0.56), *Hygrophylla auriculata* (K. Schum.) Heine (0.51) also had moderate use value (Table 4). The use values of each plant species indicate that they are the most commonly recommended and used by the respondents. Low UV scores may be due to limited information available to informants or low abundance of that species in the study area.

3.5.3. Informants consensus factor against health issues: This technique is used to highlight species that have healing potential for distinct disease category is recorded. The value of ICF ranges from 0-1 where a high ICF value indicates low use of a plant species by a large number of informants against a health issue whereas a low ICF value indicates possible disagreement about the use of a particular plant species to treat the health problem.

The ICF value is calculated using ICPC-2 or the international classification of primary care, second edition, is a standard tool of updated disease category (Anonymous, 2024). ICPC-2 is structured into chapters that correspond to body systems or components of care and each chapter represents symptoms, diagnoses and other clinical activities (Phumthum and Balslev, 2020). Table 4 represents the 11 chapters of ICPC-2 category

Table 3. Formulation of ethnomedicine and their mode of administration

Sl. No.	Formulation*	Plant species	Mode of administration
1	MF1	<i>Abutilon indicum</i> (L.) Sweet	Fruits and leaves are crushed to make a paste and are applied to the infected area.
2	MF2	<i>Achyranthes aspera</i> L.	Extract prepared by crushing the root is consumed orally with salt for the treatment of dysentery.
3	MF3	<i>Aegle marmelos</i> (L.) Correa	Juice of fruit pulp is consumed for acidity or gastric problems.
4	MF4	<i>Aloe barbadensis</i> Mill.	A small amount of leaf gel is applied to acne and insect bites. Leaf gel juice can be consumed for constipation.
5	MF5	<i>Alstonia scholaris</i> (L.) R Br.	A spoonful of milky latex, sheep's milk and salt is consumed to cure mouth ulcers.
6	MF6	<i>Ananas comosus</i> L.	Fruit juice or fruit consumption is good for gastric problems.
7	MF7	<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Soak the whole plant in water overnight, that water extract should be consumed in the morning on an empty stomach.
8	MF8	<i>Aristolochia indica</i> L.	Root extract is to be taken to treat snake bite.
9	MF9	<i>Asparagus racemosus</i> Willd.	Root extract should be taken once a day to control diabetes. It can be given with sugar candy for liver problem.
10	MF10	<i>Azadirachta indica</i> A. Juss.	The leaves can be chewed directly or used for cooking. The leaves are crushed to make a paste and used to cure acne, rash, bacterial skin infection, chicken and small pox.
11	MF11	<i>Bacopa monnieri</i> (L.) Pennell	An extract prepared by crushing leaves or stem is taken in the morning with water before breakfast as a memory enhancer.
12	MF12	<i>Barleria lupulina</i> Lindl.	The leaf juice is extracted by rubbing to use it on cut area.
13	MF13	<i>Calotropis gigantea</i> (L.) W. T. Aiton	Leaves are warmed and applied to cure arthritis.
14	MF14	<i>Carica papaya</i> L.	For the treatment of dengue, the extracted leaf juice should be taken in the morning. Eating fruits is very beneficial for improving digestion.
15	MF15	<i>Catharanthus roseus</i> (L.) G. Don	Fresh leaves can be chewed directly on empty stomach in the morning for diabetes.
16	MF16	<i>Centella asiatica</i> (L.) Urban	Fresh leaves can be chewed or crushed to make small pills and should be taken in the morning on empty stomach to treat diarrhoea or constipation.
17	MF17	<i>Cissus quadrangularis</i> L.	The stems were ground into paste and mixed with soil and it is applied externally to the fractured area with a cane like plaster.
18	MF18	<i>Coccinia grandis</i> (L.) Voigt.	One young fruit should be chewed daily in the morning on an empty stomach for diabetes.
19	MF19	<i>Coriandrum sativum</i> L.	Drink warm water after chewing the seeds or soak the seeds overnight in water and drink that water in the morning on an empty stomach as digestive stimulant.
20	MF20	<i>Curcuma longa</i> L.	Small pieces of rhizome can be chewed in the morning on an empty stomach for blood purification. Its paste is also applied to the skin rash and wounds for healing. A mixture of rhizome paste, ajwain seeds and mustard oil is heated and the hot mixture is used to apply on deep cuts.
21	MF21	<i>Cymbopogon citratus</i> (DC.) Stapf	Boil the leaf pieces in water and drink it as tea in the morning to cure cold and cough.
22	MF22	<i>Cynodon dactylon</i> (L.) Pers	Cut the tip of three leaves evenly and tickle the nose for sinus problem.
23	MF23	<i>Euphorbia nerifolia</i> L.	The leaves are bake to extract the juice and mixed with honey to cure cold and cough.
24	MF24	<i>Ficus racemosa</i> L.	Fresh young fruit should be eaten during diarrhoea and dysentery.
25	MF25	<i>Glycyrrhiza glabra</i> L.	Half finger size root is chewed for its juice for sore throat and cough.

26	MF26	<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult	Fresh leaves should be chewed on an empty stomach to manage diabetes.
27	MF27	<i>Hibiscus rosa-sinensis</i> L.	Fresh petals can be eaten raw to control irregular menstruation. To cure boils, paste of the leaves is applied around the boils.
28	MF28	<i>Holarrhena antidysenterica</i> (L.) Wall. ex A. Don.	Raw barks of stem are collected to make half cup of water decoction and given orally to cure dysentery.
29	MF29	<i>Hygrophila auriculata</i> (K. Schum.) Heine	The leaves are boiled to make a decoction and taken at least twice a day to increase blood cell count. It can be cooked as vegetable dish.
30	MF30	<i>Ipomoea aquatica</i> Forssk.	Grind the twig with a stone spice grinder to extract the juice and apply it on the insect bitten area.
31	MF31	<i>Jatropha curcus</i> L.	The collected latex should be consumed with sugar-cane in the morning on empty stomach for treating dysentery.
32	MF32	<i>Jatropha gossypifolia</i> L.	The latex containing twig can be used to clean teeth with salt and latex is also useful for treating dysentery.
33	MF33	<i>Justicia adhatoda</i> L.	Decoction of the leaves should be taken in the morning on an empty stomach to cure fever, bronchitis, cold and cough.
34	MF34	<i>Mangifera indica</i> L.	Grind the seeds and make small round pills and eat in the morning on an empty stomach to treat diabetes.
35	MF35	<i>Moringa oleifera</i> Lam.	Leaf extract should be taken in the morning or can be consumed as green leafy dish to lower the blood pressure.
36	MF36	<i>Nerium oleander</i> L.	Milky juice collected from the stem is applied directly to the eye to treat conjunctivitis. The roots of this plant have to be chewed when bitten by a snake.
37	MF37	<i>Nyctanthes arbor-tristis</i> L.	A spoonful of leaf extract with honey should be taken in the morning on empty stomach to recover from fever.
38	MF38	<i>Ocimum tenuiflorum</i> L.	One spoon of leaf extract with half spoon honey should be administered orally 1 to 2 times a day to cure cough, fever, bronchitis.
39	MF39	<i>Phyllanthus emblica</i> L.	Fresh raw fruit or its juice can be consumed on empty stomach to treat digestive problem. It can be consumed in dried powder form or as dry fruit to treat indigestion. Fresh raw fruits boiled in coconut oil for hair growth.
40	MF40	<i>Phyllanthus niruri</i> L.	The leaves are crushed to get half cup of juice and taken orally along with two spoon curd early in the morning on an empty stomach for treating jaundice and liver problems.
41	MF41	<i>Psidium guajava</i> L.	1-2 young leaves rubbed and used to clean teeth instead of tooth paste. 3-5 young leaves along with ginger crushed to extract the juice and consumed orally for diarrhoea and dysentery. Oral administration of a spoonful of stem bark juice is useful to treat diarrhoea.
42	MF42	<i>Rauvolfia serpentina</i> (L.) Beth ex Kurz or <i>Rauvolfia tetraphylla</i> L.	After being bitten by a snake, a person must chew raw roots and consume the juice.
43	MF43	<i>Shorea robusta</i> Gaertn. F.	One spoonful of fruit extract is taken to treat diarrhoea and dysentery.
44	MF44	<i>Swietenia mahagoni</i> (L.) Jacq. or <i>Swietenia macrophylla</i> King	Grind the seeds and make round pills as the shape of pepper. It should be administered in the morning on empty stomach for 15 days. If it lowers the sugar level then a diabetic person has to stop eating it and start drinking leaf juice of <i>Hygrophilla auriculata</i> .
45	MF45	<i>Syzygium cumini</i> (L.) Skeels	It can be consumed in dry powdered form or in raw form made into small round pills. It should be taken on empty stomach in the morning for treating diabetes.

46	MF46	<i>Tagetes erecta</i> L.	Leaf juice is applied on fresh cuts and wounds.
47	MF47	<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	The bark should be soaked in a glass of water overnight to get extract. The water extract should be consumed on empty stomach in the morning for acidity.
48	MF48	<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms.	One small finger sized stem is boiled in hot water till water reduce to half cup and consumed it in the morning on empty stomach for rheumatoid arthritis.
49	MF49	<i>Tridax procumbence</i> L.	The leaves should be rubbed with hands to get the juice and should be applied externally on the cut or wound area.
50	MF50	<i>Zingiber officinale</i> Roscoe	Small piece of rhizome with little amount of salt is chewed when a person getting cold.
51	PF1	<i>Asparagus racemosus</i> Willd. + <i>Hemidesmus indicus</i> (L.) R. Br. + <i>Phyllanthus emblica</i> L. + <i>Terminalia chebula</i> Retz. + <i>T. Bellirica</i> (Gaert.) Roxb. + <i>Glycyrrhiza glabra</i> L.	All the dried materials are grinded and mixed with black salt on the basis of taste. One spoon of powdered mixture should be taken orally with half glass of water on empty stomach to treat gastric problems.
52	PF2	<i>Azadirachta indica</i> A. Juss. + <i>Curcuma longa</i> L.	Leaf of <i>A. indica</i> and the rhizome of <i>C. longa</i> are crushed together to prepare a paste and applied to the infected areas as antibacterial agent.

*MF- Monoherbal formula; PF- Polyherbal formula

Table 4. List of chapters of ICPC-2 disease categories linked to symptoms or primary treatments or components of care with Nur, Nt and ICF value.

Sl. No.	Chapter by ICPC-2	Symptoms related to ICPC-2 category	Nur	Nt	ICF
1	S: Skin	Acne, antiaging, bacterial skin infection, boil, cut and wound, hair care, insect bite, skin care, skin rash and snake bite	43	14	0.69
2	D: Digestive	Acidity, constipation, diarrhoea, dysentery, gastric problem, improve digestion, jaundice, liver problem, mouth ulcer, swollen gums and pain and toothache	45	23	0.5
3	L: Musculoskeletal	Arthritis, bone fracture and rheumatoid arthritis	13	03	0.83
4	T: Endocrine/ metabolic and nutritional	Diabetes, obesity and scurvy	43	11	0.76
5	K: Cardiovascular	Blood pressure	15	01	01
6	B: Blood, blood forming organ and mechanism	Blood purifier and increase blood cell count	40	03	0.94
7	R: Respiratory	Bronchitis, cold and cough, Sinus problem and sore throat	43	08	0.83
8	F: Eye	Conjunctivitis	06	01	01
9	A: General and unspecified	Chicken pox, dengue treatment, fever and small pox	41	06	0.87
10	X: Female Genital	Irregular menstruation cycle and leucorrhoea	17	02	0.93
11	P: Psychological	Memory enhancer	16	01	01

Nur - Number of use citations in each alignment category; Nt - Number of plant taxa used for a particular alignment category; ICF - Informant Consensus Factor

linked to symptoms or treatments or components of care. In this investigation, highest ICF value (ICF=1) was noticed for cardiovascular, eye and psychological disease chapter of ICPC-2 category followed by blood, blood forming organ and mechanism (0.94) and female genital (0.93). Similarly, the next highest ICF value is shown in general and unspecified disease category by ICPC-2 system (0.87). The lowest ICF value is observed in the chapter of digestive includes acidity, constipation, diarrhoea, dysentery, gastric problem,

improve digestion, jaundice, liver problem, mouth ulcer, swollen gums and pain, toothache.

3.5.4. Percentage of fidelity level: Fidelity level (FL%) is used to determine the percentage of informants who reported the certain plant species to treat specific health problem during the survey (Dey and De, 2012). Highest fidelity level was noticed for 39 plant species and the fidelity level below 50% was noticed for three plant species (Table 5).

Table 5. Fidelity Level (%) of particular ailment treated by specific plant taxa.

Sl. No.	Therapeutic use	Name of species	Ip	Iu	Fidelity level (%)
1	Acne	<i>Aloe barbadensis</i> Mill.	29	31	93.54
		<i>Azadirachta indica</i> A. Juss.	18	40	45
2	Acidity	<i>Aegle marmelos</i> L. Correa	9	12	75
		<i>Terminalia arjuna</i> (Roxb.) Wight & Arn.	13	13	100
3	Antiaging	<i>Aloe barbadensis</i> Mill.	27	31	87.09
4	Arthritis pain	<i>Calotropis gigantea</i> (L.) W. T. Aiton	7	7	100
5	Bacterial skin infection	<i>Abutilon indicum</i> (L.) Sweet	5	5	100
		<i>Azadirachta indica</i> A. Juss.	20	40	50
6	Blood Pressure	<i>Moringa oleifera</i> Lam.	15	17	88.23
7	Blood Purifier	<i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees	34	35	97.14
		<i>Azadirachta indica</i> A. Juss.	27	40	67.5
		<i>Curcuma longa</i> L.	25	32	78.12
8	Boil treatment	<i>Hibiscus rosa-sinensis</i> L.	10	15	66.66
9	Bone fracture	<i>Cissus quadrangularis</i> L.	5	5	100
10	Bronchitis	<i>Justicia adhatoda</i> L.	32	35	91.42
		<i>Ocimum tenuiflorum</i> L.	19	28	67.85
11	Cold & Cough	<i>Justicia adhatoda</i> L.	29	35	82.85
		<i>Cymbopogon citratus</i> (DC.) Stapf	16	16	100
		<i>Euphorbia nerifolia</i> L.	6	6	100
		<i>Moringa oleifera</i> Lam.	12	17	70.58
		<i>Ocimum tenuiflorum</i> L.	26	28	92.85
		<i>Zingiber officinale</i> Roscoe.	34	35	97.14
12	Constipation	<i>Aloe barbadensis</i> Mill.	28	31	90.32
		<i>Centella asiatica</i> (L.) Urban	22	25	88
13	Cut & wound	<i>Barleria lupulina</i> Lindl.	7	7	100
		<i>Curcuma longa</i> L.	28	32	87.5
		<i>Tagetes erecta</i> L.	14	14	100
		<i>Tridax procumbens</i> L.	10	10	100
14	Dengue treatment	<i>Carica papaya</i> L.	23	28	82.14
15	Diabetes	<i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees	33	35	94.28
		<i>Asparagus racemosus</i> Willd.	12	16	75
		<i>Azadirachta indica</i> A. Juss.	37	40	92.5
		<i>Catharanthus roseus</i> (L.) G. Don	9	9	100
		<i>Coccinia grandis</i> (L.) Voigt.	5	5	100
		<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult	9	9	100
		<i>Mangifera indica</i> L.	9	9	100
		<i>Swietenia mahagoni</i> (L.) Jacq.	15	15	100
		<i>Swietenia macrophylla</i> King	15	15	100
		<i>Syzygium cumini</i> (L.) Skeels	14	14	100
		<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms.	8	9	88.88
16	Diarrhoea	<i>Centella asiatica</i> (L.) Urban	23	25	92
		<i>Ficus racemosa</i> L.	8	10	80
		<i>Psidium guajava</i> L.	11	15	73.33
		<i>Shorea robusta</i> Gaertn. f.	9	13	69.23
17	Dysentery	<i>Achyranthes. Aspera</i> L.	10	10	100
		<i>Ficus glomerata</i> Roxb.	6	10	60
		<i>Holarrrheana antidynterica</i> Wall. ex G. Don.	7	7	100
		<i>Jatropha curcus</i> L.	9	9	100
		<i>Jatropha gossypifolia</i> L.	8	10	80
		<i>Psidium guajava</i> L.	9	15	60
		<i>Shorea robusta</i> Gaertn. f.	10	13	76.92

18	Eye conjunctivitis	<i>Nerium oleander</i> L.	6	13	46.15
19	Fever	<i>Justicia adhatoda</i> L.	32	35	91.42
		<i>Nyctanthes arbor-tristis</i> L.	26	28	92.85
		<i>Ocimum tenuiflorum</i> L.	26	28	92.85
20	Gastric problem	<i>Aegle marmelos</i> (L.) Correa	9	12	75
		<i>Ananas comosus</i> L.	10	11	90.90
		<i>Asparagus racemosus</i> Willd.	8	16	50
		<i>Glycyrrhiza glabra</i> L.	6	8	75
		<i>Hemidesmus indicus</i> (L.) R. Br.	6	6	100
		<i>Phyllanthus emblica</i> L.	18	19	94.73
		<i>Terminalia bellirica</i> (Gaertn.) Roxb.	8	8	100
21	Hair care	<i>Terminalia chebula</i> Retz.	8	8	100
		<i>Phyllanthus emblica</i> L.	17	19	89.47
22	Improves digestion	<i>Aloe barbadensis</i> Mill.	25	31	80.64
		<i>Carica papaya</i> L.	23	28	82.14
		<i>Coriandrum sativum</i> L.	12	12	100
23	Increase blood cell count	<i>Zingiber officinale</i> Roscoe	34	35	97.14
24	Insect bite	<i>Hygrophila auriculata</i> (K. Schum.) Heine	23	23	100
25	Irregular menstruation cycle	<i>Ipomoea aquatica</i> Forssk.	5	5	100
		<i>Aloe barbadensis</i> Mill.	12	31	38.70
26	Jaundice	<i>Hibiscus rosa-sinensis</i> L.	11	15	73.33
27	Liver problem	<i>Phyllanthus niruri</i> L.	8	9	88.88
28	Memory enhancer	<i>Asparagus racemosus</i> Willd.	12	16	75
		<i>Phyllanthus niruri</i> L.	6	9	66.66
29	Mouth ulcer	<i>Bacopa monnieri</i> (L.) Pennell	16	16	100
30	Obesity	<i>Alstonia scholaris</i> (L.) R. Br.	5	5	100
31	Rheumatoid arthritis	<i>Moringa oleifera</i> Lam.	13	17	76.47
32	Scurvy	<i>Tinospora cordifolia</i> (Thunb.) Miers. ex Hook. f. & Thoms.	5	9	55.55
33	Sinus problem	<i>Ananas comosus</i> L.	8	11	72.72
34	Skin care	<i>Cynodon. Dactylon</i> (L.) Pers.	3	3	100
35	Skin rash	<i>Aloe barbadensis</i> Mill.	29	31	93.54
		<i>Azadirachta indica</i> A. Juss.	35	40	87.5
36	Snake bite	<i>Curcuma longa</i> L.	28	32	87.5
		<i>Aristolochia indica</i> L.	12	12	100
		<i>Nerium oleander</i> L.	8	13	61.53
		<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	15	15	100
37	Small pox and Chicken pox	<i>Rauvolfia tetraphylla</i> L.	15	15	100
		<i>Azadirachta indica</i> A. Juss.	24	40	60
38	Sore throat with cough	<i>Moringa oleifera</i> Lam.	15	17	88.23
39	Stomach tape worm	<i>Glycyrrhiza glabra</i> L.	6	8	75
40	Swollen gums and pain	<i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees	32	35	91.42
41	Toothache	<i>Jatropha gossypifolia</i> L.	8	10	80
42	White discharge	<i>Psidium guajava</i> L.	12	15	80
		<i>Asparagus racemosus</i> Willd.	8	16	50

4. Conclusion

In our study, it was found that ethnomedicine used by local inhabitants against various ailments and the traditional wisdom is orally inherited from their ancestors. This time-tested information of indigenous therapy is vanishing rapidly due to urbanization, lack of interest among young generations, lack of conservation and ignorance. Local villagers suffer from a number of ailments due to poor health and hygiene, lack of modern hospital facilities, contamination of water and food, lack of drainage facility, etc. They prefer their own traditional therapy over other therapeutics due to they are inexpensive, readily available and with lower side effects. The local inhabitants too much dependent on ethnomedicine for primary health care. Most of the ethnomedicines reported in this study are used to cure or decrease the harmfulness of ailments. A number of medicinal plants also used to alternative system of medicine. Further phytochemical investigation and bioactivity assay may identify the novel compounds responsible for the treatment of particular ailments. Although paschim Medinipur district was rich in plant diversity, the effort to conserve the medicinal plants and associated traditional wisdom was observed to be very sparse. Thus, conservation of ethnomedicine by local people and responsible bodies is essential. Proper conservation techniques are also needed for the sustainable utilization of ethnomedicine which will prevent over exploitation.

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